Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Seventh Semester

Chemical Engineering

CH3701- Chemical Reaction Engineering II

(Assume any missing data suitably, if necessary)

Regulations - 2021

Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BTL*	*CO*	*Marks*
1.	Define shrinking core model in non-catalytic reactions.	L1	1	2
2.	State the difference between film resistance and ash layer resistance.	L2	1	2
3.	Write the Freundlich adsorption isotherm equation.	L1	2	2
4.	What are catalyst poisons? Give an example.	L1	2	2
5.	Differentiate between single site and dual site catalytic mechanisms.	L2	3	2
6.	State the Langmuir-Hinshelwood kinetic model.	L1	3	2
7.	Define Thiele modulus.	L1	4	2
8.	What is effectiveness factor for non-isothermal conditions?	L2	4	2
9.	Write two factors affecting the design of a tower reactor.	L1	5	2
10.	Mention two differences between absorption with and without chemical reaction.	L2	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a		A non-porous solid particle reacts with a gas according to the SCM. Derive an expression for the time required for complete conversion when the reaction is controlled by diffusion through the ash layer.	L3	1	16
			Or			
	b		A batch of coal ash particles of mixed sizes (30% by weight are 2 mm, 50% are 1 mm, and 20% are 0.5 mm) is to be burned in a fluidized bed reactor. The reaction is gas-film diffusion controlled. The time for complete conversion of a 1 mm particle is 10 minutes. Calculate the time needed for complete conversion of the entire batch.	L3	1	16
12.	a	i	Discuss the role of catalyst promoters, inhibitors, and poisons in modifying the activity and selectivity of a solid catalyst. Provide one industrial example for each.	L2	2	8
		ii	Explain the methods for the determination of void volume determination of catalyst particle.	L2	2	8
			Or			

	b	i	Explain the physical significance and the procedure to determine the following properties of a solid catalyst: (i) Solid density, (ii) Particle density, (iii) Porosity (void fraction).	L2	2	8
		ii	Explain about Physisorption and Chemisorption based on adsorption theory.	L2	2	8
13.	a	i	The hydrogenation of ethylene (A) to ethane (C_2H_6) on a nickel catalyst is believed to follow a Langmuir-Hinshelwood mechanism with dual-site surface reaction as the rate-determining step (RDS). The reaction is: $C_2H_4 + H_2 \rightarrow C_2H_6$ Propose a plausible mechanism and derive the final rate equation. (Assume hydrogen adsorption is dissociative).	L3	3	8
		ii	Derive the rate equation A→2B for a reaction using the Langmuir-Hinshelwood mechanism.	L3	3	8
			Or			
	b		Develop the design equation batch reactor and a continuous reactor for the kinetics of a heterogeneous catalytic reaction.	L3	3	16
14.	a		Define the effectiveness factor (η) for a catalyst pellet. Derive the expression for the Thiele modulus (ϕ) and the effectiveness factor (η) for a first-order irreversible reaction occurring in a spherical catalyst pellet. (Assume isothermal conditions).	L2	4	16
			Or			
	b		Explain in detail about the mass and heat transfer within a catalyst pellet. With a suitable example.	L2	4	16
15.	a		Develop the design equation for packed bed tower in reaction engineering.	L3	5	16
			Or			
	b		The absorption of CO_2 into an aqueous NaOH solution is a classic example of a fluid-fluid reaction (A(g) + B(l) → Products). Derive the rate expression for the absorption of a gas A accompanied by an irreversible second-order reaction with a dissolved reactant B. State all assumptions.	L3	5	16